



**Elevating the Shield of Blows:
Theater Missile Defense for the Twenty-First
Century**

**A Monograph
by
Major Cornell T. McGhee
Air Defense Artillery**



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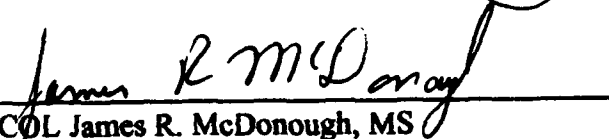
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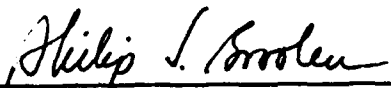
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ABSTRACT

Elevating the Shield of Blows: Theater Missile Defense for the Twenty-First Century
by Major Cornell T. McGhee, USA, 53 pages.

This monograph examines whether the operational air defense force for theater ballistic missile defense will be capable of conducting operations on future battlefields. To explore relevant issues in this area, historical examples from World War I, World War II, and Operation Desert Storm are cited as lessons learned. An examination of the Operational Air Defense Battlefield Operating Systems as specified in TRADOC Pamphlet 11-9 serves as a baseline for comparison between currently fielded air defense organizations and materiel against their ability to accomplish the mission assigned them.

The study determines that American maneuver forces are vulnerable to engagement from ballistic missiles. Current theater air defense systems and organizations are severely limited in their ability to engage ballistic missiles at their maximum effective ranges without endangering the lives of American soldiers and our allies. Organization and materiel solutions to the problem are required.

The study concludes that the Army must continue to develop and field a complementary system of theater air defense weapon systems that can destroy the full spectrum of theater ballistic missiles. The Department of Defense should create a separate theater missile defense organization from existing forces to control antimissile forces in wartime. During peacetime this organization should prepare theater missile defense doctrine and serve as the combat developer for all operational antimissile materiel systems. We must continue to advance our technological edge to negate a hostile nation's ability to employ weapons of mass destruction against the United States and her allies. We must adapt our organizations in conjunction with our technology to guarantee our ability to defeat the expected aerial threat.

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Introduction

The United States and its allies must look to their own resources to protect themselves and their forces overseas, and improved active missile defense will be a necessary ingredient in future U. S. contingency planning. ¹

There are numerous doctrinal, organizational, and materiel changes to operational air defense systems currently in development that could provide a theater commander in chief (CINC) with a credible theater ballistic missile defense on the future battlefield. Several examples in history may provide valuable insights for the development of these future weapon systems and their associated doctrine. The research question considered on this monograph is whether emerging operational air defense doctrine, organizations, and materiel reflect actual combat experiences with theater ballistic missiles and aerial operational weapons? The results of this analysis will determine the capability of the U. S. military to protect future operational maneuver forces from the threat posed by these weapons of mass destruction.

An examination of the research question will begin with a theoretical foundation for discussion using the defensive and offensive theories of Prussian General Carl von Clausewitz and United States Air Force Colonel John A. Warden. The applicability of Clausewitz's and Warden's theories to current air defense doctrine provides the framework for discussion of operational air defenses. Three historical examples of the use of operational air defenses will provide a basis for analysis of the research question. These case studies include the British experience with German Zeppelin airships during World War I, the British and American experience with German V-series rockets during World War II, and the American experience with Iraqi Scud missiles during Operations Desert Shield and Desert Storm. Evidence from official military records, the National Military Strategy, books, pamphlets, newspapers, periodicals, monographs, and briefing slides will serve as primary source material for the monograph. Additionally, information from the Joint Chiefs of Staff, the Department of the Army, the Army Space Command, the Training and Doctrine Command, and the Air Defense Artillery School augments information collected from primary and secondary sources. An analytical comparison of the evidence and the emerging operational air defense doctrine, organizations, and materiel systems

according to several criteria will answer the research question. Draft Field Manual 100-5, Operations, will provide the criteria (Agility², Initiative³, Depth⁴, Synchronization⁵, and Versatility⁶) to test doctrine. Training and Doctrine Command Pamphlet 11-9, Blueprint of the Battlefield, will provide the criteria (allocating operational air defense targets for attack⁷ and integrating joint and combined operational air defense forces⁸) to test organizations and materiel.

The operational air defense doctrine described in this paper describes how America's Army, as part of a joint antimissile team, intends to fight. It is the condensed expression of the Army's fundamental approach to fighting (campaigns, major operations, battles and engagements) and deterring actions detrimental to U. S. national interests. As an authoritative statement, doctrine must be definitive enough to guide specific operations, yet remain adaptable enough to address diverse and varied situations worldwide. ⁹

An analysis of the operational air defense organization will describe the actual forces involved in the destruction of aerial threat aircraft, missiles, and their associated command and control systems. An examination of American counterair organizations will encompass the four armed services, both individually and jointly. Organizations studied in this document will focus on Army air defense artillery brigades and battalions, Air Force fighter wings and aircraft warning and control squadrons, Navy anti-aircraft and antimissile vessels, and Marine Air Wings with organic aircraft, radar, and anti-aircraft artillery forces.

Materiel consists of all items, excluding real property and installations, needed to equip, operate, maintain, and support military personnel in sufficient quantity within resource constraints. Materiel examined in this paper will include aircraft, surface-to-air missile systems, early warning systems, and counterair communication and interface systems. A defensive theoretical foundation will provide the framework for future discussion of materiel systems, organizations and doctrine.

Defensive Theories

The Prussian General Carl von Clausewitz wrote his classic book on military theory On War, immediately after the Napoleonic period. Since that time, numerous

military theorists, such as Baron Antoine de Jomini, Helmuth von Moltke, and General Giulio Douhet have studied his work in an attempt to refute his doctrine or apply his principles to their particular military specialty.

Clausewitz's study of the two forms of combat, the offense and the defense, led him to a controversial conclusion: the defensive form of warfare was inherently stronger than the offensive. The primary aim of the defense is passive; it involves the preservation of the fighting force. The purpose of the offense is positive and concerns itself with the conquest of a foe. He felt preservation and protection of the fighting force were easier than attacking, as long as both sides have equal means. ¹⁰

The most serious drawback to the defense is that it is a negative concept; by itself, the best it can lead to is a draw, never to a positive result. Clausewitz believed that the defensive form of war was stronger, yet he felt it should only be used as long as equality or parity compels one to do so, and then abandoned as soon as the army is strong enough to pursue the positive object. When one has used defensive measures successfully, a more favorable balance of strength is usually created; the natural course in war is to begin defensively and end by attacking. Thus the defensive form of war has an offensive component. ¹¹

The concept of Clausewitzian defense focuses on the parrying, or the dodging, of a blow. A properly constituted defense should be designed to ward off or evade the advances of an attacker; its characteristic feature involves awaiting the blow. The defensive combatant does not actively seek combat outside the confines of the defended area but remains within a defensive perimeter, constructing a protective shield of blows (fortifications and defensive positions), awaiting the attack of the enemy and absorbing the blows of the attacker. The primary object of this defensive focus is to preserve the fighting force. By shielding the fighting force from the blows or the thrusts of an attacker, the defender limits the damage that could be inflicted on the army, the weapons, or the supplies that support the war effort. Clausewitz believed a successfully conducted defense preserves the fighting force until the time of the defender's choosing. ¹²

There are three phases to Clausewitz's defensive battle: the construction of defensive positions, the initial parrying of a blow, and the offensive component--the

counterthrust. In the first phase, the defender should prepare fighting positions or fortifications that are designed to absorb the blows of an attacker; this is known as the shield of blows. Successfully constructed defensive positions allow the defender to absorb all the attacker's thrusts without suffering significant losses of combat power. According to Clausewitz, the use of time is a critical component for both the defender and the initiator. Time that is allowed to pass unused accumulates to the credit of the defender as delays in fending the attacker's blows permit the defender to improve his defensive positions.¹³

Using familiar terrain to construct defensive positions is key in the defender's ability to thwart offensive advances of the enemy because the attacker must approach an entrenched force on easily observed routes. With the invader approaching on these likely avenues of approach, the defensive army may remain concealed and virtually invisible to the opponent until the decisive moment arrives. Should the attacking army strike into the strength of the prepared defensive positions, they could potentially suffer tremendous loss of combat power and be prime for the third phase of the defensive battle, the counterthrust.¹⁴

The second phase of the defense involves the parrying or the dodging of the blows of an attacking force. The defending army must be capable of avoiding the offensive capability of the attacker to guarantee survival of not only the fighting force, but the nation as well. If the defensive army has successfully accomplished its mission, the attacking force should be weakened so significantly that the predominance of combat power rests with the defender.

The attacker has certain advantages that may interfere with the proper execution of the Clausewitzian defense. Given that the defender cannot protect the entire countryside simultaneously, there could exist certain weaknesses in the defensive fortifications that the attacker might exploit. "The one advantage the attacker possesses is that he is free to strike at any point along the whole line of defense and in full force."¹⁵ To exploit successfully the attack into another country, the offensive armies must conduct a thorough analysis of the terrain and have near-perfect knowledge of the defending armed forces' locations and strengths. Provided the attacking commander has made the proper analysis and the defending

armed force is unable to defend properly the area of responsibility at the point of attack, the offensive-oriented army could prevail.

The final phase of the defensive battle, the counterattack or counterthrust, is one of Clausewitz's more controversial precepts because its application is often misunderstood. The idea of an offensive component to defensive warfare appears to be a contradiction in terms, yet the duality of defensive warfare is quite logical in its application. "If we are really waging war, we must return the enemy's blows; and these offensive acts in a defensive war come under the heading of defense." ¹⁶ The entrenched force must achieve a favorable balance of power in the initial two phases of the defense if the offensive nature of the defense is to be successful.

Success for the defender is predicated on the invader reaching a culminating point, that is, the inability to project sustained combat power. After the attacker has culminated, the defending force must strike back at the weakened foe to hasten a surrender or a withdrawal from friendly terrain. "A sudden powerful transition to the offensive—the flashing sword of vengeance—is the greatest moment for the defense." ¹⁷ It is this final stage of the defensive operation that preserves the ability of the defender to protect the nation.

A modern illustration of the Clausewitzian defensive principle is the "rope-a-dope" boxing strategy used by the former world heavyweight champion Mohammed Ali. The preparations for this defensively oriented strategy began outside the boxing ring when Ali physically prepared his body for the ensuing combat; this is analogous to the army defender preparing his shield of blows. At some point during the fight, Ali would lean on the ropes and protect his head and midsection with his gloves, while his opponent would deliver blow after blow to Ali's protected body. Since Ali had prepared himself for combat, he was able to absorb all the blows his opponent could deliver. Ali would wait until his foe was exhausted from throwing punches, emerge from his protective shield, and deliver the flashing sword of vengeance—the knockout blow—to his bedazzled opponent.

Clausewitz could not have imagined the development of air defense, yet his defensive principles retain a universal character that makes them applicable to all types of warfare. An air defense force with the proper doctrine, organization, and

materiel has the potential to weaken significantly the attacking force. A properly deployed air defense shield can protect and preserve the defended force and allow a ground or aerial maneuver force to return the blows of the attacker. Since the overriding mission of air defense forces, both ground and air, is to allow the ground commander the freedom to maneuver on the battlefield, air defense artillery constitutes the optimum shield of blows for the future battlefield.

Colonel John A. Warden III, a United States Air Force officer and contemporary airpower theorist, disagrees. Warden contends that no defense against the proper use of airpower is presently possible, although he does acknowledge the future possibility of a credible defense. He recognizes Clausewitz's doctrine, yet maintains it is not applicable to his offensive theory of air warfare. "The defense, in classical land warfare, may well be stronger than the offense, as Clausewitz postulated. In air war, however, the opposite seems to be the case."¹⁸

Colonel Warden asserts there are three reasons for such a belief. First, air forces can move with such freedom over the battlefield that they can instantaneously attack from numerous directions, something a land army cannot do well. Second, because the air force can move so swiftly, it is impossible to concentrate a defensive force against it. Third, since early air defense systems did not fire on the move (Chaparral¹⁹ and Hawk²⁰), Colonel Warden believes that when air defenders moved out of prepared positions they would lose their positional advantage over the attacker.²¹

His assertions may be correct concerning older, short-range, low-altitude weapons, but they are incorrect with regard to modern and emerging air defense systems. The speed of high performance aircraft is almost irrelevant to current and emerging medium and high altitude air defense weapons. Modern defensive systems can locate, track, engage and destroy aircraft before the pilot can undertake any effective defensive maneuvers. Further physical restrictions complicate the problem for fixed wing aviators. The physical evasive maneuvers of fixed wing aircraft are limited to the amount of Gs, or gravity forces, the pilot can withstand. The man in control of the airplane will lose consciousness and therefore control of the aircraft after pulling too many Gs. The medium and high altitude air defense system *pilot*, or

tactical control officer, does not suffer from these limitations; his cockpit is on the ground in a protected shelter.

If an aircraft must traverse defended territory to accomplish its mission, its speed is irrelevant; current antiaircraft missiles travel much faster than today's airplanes. Ground air defense weapon systems also benefit from their proximity to the defended force. Given the advancements in missile propulsion and technology, these weapon systems do not have to venture out into the unknown countryside to seek their prey; rather their victims always come to them. Antiaircraft artillery should be positioned around the key critical assets and maneuver forces that the CINC deems necessary. After sufficient weapons systems have been concentrated around the defended asset, there is no need to reposition those fire systems, unless the defended asset moves.

Modern air defense systems can defend ground forces against air attack from any direction. Though most medium and high altitude surface-to-air missile systems cannot fire on the move, all the weapon systems in a given area of operations do not abandon the ground forces to reposition their defenses simultaneously. As long as enough ground-positioned air defense systems remain available to protect the maneuver force, an adequate defense against aerial weapons may be maintained. Under further analysis, the strength of Clausewitz's defensive doctrine remains viable, although its application is no less controversial. In the current debate on service roles and missions, the United States Army and Air Force disagree on the application of air defense doctrine and the forces that implement it.

Air Defense Doctrine

The overriding mission of air defense forces is to allow the ground commander the freedom to maneuver on the battlefield. The greatest potential threat to American military forces on the future battlefield is from aerial delivered weapons of mass destruction. The doctrinal solution to reduce the effectiveness of these weapons relies on two fundamentally different approaches, ADA or aircraft weapons systems. An ADA weighted defensive force is the doctrinal solution favored by the American Army. An aircraft weighted defense force is the approach favored by the United

States Air Force. Each service, either individually or in tandem, could serve as that shield of blows that protects and preserves the fighting force. However, only the Air Force can serve as the flashing sword of vengeance; Army air defense weapons are purely defensive. Given the fiscal constraints on future weapon system acquisition, force designers must choose the most effective air defense force structure to protect American forces from hostile aerial threats.

Air defense artillery systems have several advantages over aircraft that make them attractive as the primary shield of blows against aerial threats. These modern weapons are highly mobile, can remain with the protected force during the battle, and can also operate twenty-four hours per day under all climactic conditions. Systems such as Avenger²², Patriot²³, and the Corps Surface to Air Missile system (Corps SAM)²⁴ can or are planned to negate the effectiveness from the full spectrum of projected threats such as ballistic and cruise missiles, unmanned aerial vehicles, and rotary wing and fixed wing aircraft.

There are also several disadvantages to an ADA dominated shield of blows. Due to fiscal constraints for ADA weapon system acquisition, there are often not enough weapons to protect each designated critical asset. Historically, ground commanders have requested large numbers of weapon systems to protect command and control centers, headquarters and operation centers, key logistics facilities, nuclear delivery systems, refueling and rearming sites, ports of embarkation and debarkation, fighter bases and maneuver forces. Due to a lack of systems, some of these critical assets were often left without ground air defense protection. In simple terms, the United States military does not have all the air defense weapons necessary to protect every critical asset on the modern battlefield from aerial threats.

Another disadvantage is that ground systems are susceptible to destruction from a multitude of systems other than aircraft. The suppression of enemy air defenses (SEAD) is an effective doctrinal method to deny air defense effectiveness against high performance aircraft. During SEAD missions one force attempts to neutralize, destroy, or temporarily degrade enemy air defense systems in a specific area by physical attack (rocket or cannon artillery) and/or electronic combat to enable tactical air operations to be successfully conducted. The results of a SEAD campaign

are often temporary; the air defense system can move away from the area under attack or turn off the affected radar to negate the effects of the electronic combat. Either way, the attacking air force may have produced just the advantage necessary to be successful on the battlefield. The continual development of counter and counter-countermeasures guarantee that this vicious cycle will continue in the future.

Aircraft are not viable weapons platforms for the destruction of all classes of threat aerial weapons. The effectiveness of high performance aircraft against ballistic missiles, rotary wing aircraft and unmanned aerial vehicles is limited. However, these threats are the continual concern of ground force commanders. Whether technology can provide solutions for aircraft to destroy these different types of aerial platforms with the same precision as ground air defense systems remains to be seen.

Another disadvantage for an aircraft-oriented shield of blows is that aircraft configured for two different types of missions, such as air superiority and close air support, may perform neither as well as a single aircraft designed for one particular function. In the current drawdown of military services, the growing trend is to require materiel systems to perform more than one function. Multifunctionality may be possible for certain equipment such as helicopters and cargo vehicles, but not high performance aircraft.

Air superiority aircraft ensure that the skies above maneuver forces remain clear from threats, such as fixed wing aircraft, which could detract from success on the ground. The advantage of an aircraft predominant force is that the CINC may use these weapon systems in both an offensive and defensive role. Used in this manner, the airplane then serves as the shield of blows (defensive) and the sword of vengeance (offensive).

However, air superiority achieved early in a campaign does not guarantee a ground force's absolute freedom from air attack. The infiltration of even one remotely piloted vehicle with a nuclear or chemical payload could prevent the accomplishment of operations in the closefight. The elimination of the enemy's offensive air capability in the counterattack phase is the only method to accomplish absolute air defense protection. The following three historic examples may provide force designers the necessary insight to construct an effective twenty-first century air defense.

Historical Perspectives on Operational Air Defense

Experience with aerial weapons of mass destruction began in Great Britain during World War I. Since the Royal Navy could reasonably protect England from any sea-borne invasion, the airways were the path of least resistance to invade Britain. The Germans flew bomber aircraft against the British, but their most significant aerial weapon of mass destruction was the dirigible. Originally constructed for transportation purposes, the Zeppelin airship could carry numerous bombs and incendiary devices across the English Channel and strike industrial and military targets with impunity.

The L-30 model Zeppelin was a formidable craft. It had a volume of two million cubic feet of hydrogen, weighed over 80,000 pounds, and could lift 31 tons. The aircraft was 650 feet long, as tall as a ten-story building and could attain a maximum speed of about sixty-five miles per hour. The airship could carry five tons of high explosives and incendiaries to an altitude of thirteen thousand feet.²⁵

Parliamentary committees began to investigate Britain's ability to resist attack from airplanes and airships as early as 1908. Although a general awareness existed among politicians, defense officials, and military officers of the threat that Germany's growing fleet of Zeppelins posed to Britain, no important action to provide the country with an efficient air defense occurred before the war. The danger posed by the new air weapon was still obscure, and most British citizens equated the danger from air attack posed by the airships with fantasies such as those described in H. G. Wells' futuristic novels.²⁶

British air defense organizations preceded air defense doctrine. When the war began, Britain had no aircraft squadrons specially designated for home defense, and the Army's entire Royal Flying Corps was posted to France. Responsibility for air defense thus fell to the Admiralty which controlled seaplanes, while the Royal Garrison Artillery supplied most of the heavy guns used in the air defense role on British soil.²⁷

On 3 September 1914, Winston Churchill, as State Secretary of the Admiralty, assumed responsibility for the air defense of Britain. Churchill began by composing the first carefully considered expression of air defense theory. Churchill stated that

the best defense is a good offense. In his memorandum, he offered pragmatic suggestions for the combined employment of pursuit planes, sound detectors, searchlights, observers, and antiaircraft artillery.²⁸

Britain's doctrinal solution to the bombing problem was known as forward air defense. In this approach, friendly aircraft attempted to destroy Zeppelin airships as far away from their targets as possible. In this application of the offensive form of the defense, aircraft destroyed Zeppelin airships in their assembly plants and on the ground before they could be launched from Belgian airfields. British naval airplanes, launched from established airfields near the French port of Dunkirk, enjoyed moderate success, forcing Germany to abandon its airfields in Belgium. But they did not halt construction of the airships. The Germans simply constructed more Zeppelin sheds in the parts of occupied France that Allied aircraft could not reach.

Zeppelin raids were scheduled for arrival over the target area at night in the dark of the moon--a period extending from eight days before the new moon to eight days after. Arriving over their objectives in the darkest hours of the night, they were not as visible from either the ground or from British observation balloons. A successfully timed attack afforded them plenty of time to drop their bomb loads and travel back to Germany before dawn.²⁹

The initial German airship attack almost paralyzed Great Britain, which at the time had no system to predict when or where the Zeppelins would arrive. Even when the British first detected the dirigibles, they had no planes or artillery capable of reaching the enemy craft that cruised at great altitudes and selected their targets at will.³⁰

The British defensive forces had several problems countering the Zeppelin menace. English airplanes were not equipped for night fighting; even in daylight they had difficulty climbing to the proper altitude in time to attack the airships. Searchlight crews could not hold their lights in focus for more than a few seconds, and that reduced the effectiveness of firing the antiaircraft artillery (AAA) guns at night. AAA units could not estimate the range to the targets or anticipate Zeppelin movements, and despite the early warning gunnery officers still had to aim and engage the target.³¹

Advancements in technology began to favor the defense when British aerial air defense units received explosive and incendiary bullets for their machine guns and equipped their fighter planes to fly at the same high altitudes as the Zeppelins. On September 2, 1916, First Lieutenant William Leefe Robinson became the first Royal Flying Corps pilot to destroy an enemy Zeppelin in flight using incendiary ammunition. The military widely publicized the success of this attack and British morale soared in a manner foreshadowing Patriot missile success against Iraqi Scud missiles in the 1991 Persian Gulf War.³²

In July 1917, Great Britain established the London Air Defense Area (LADA). The system used air defense components such as antiaircraft guns for target engagements, searchlight batteries for nighttime target location, pursuit planes, barrage balloon screens, and inland and coastal observer posts. In actual operation though, the LADA network experienced several difficulties.³³

Before takeoff observers and plotters could only provide pilots with approximate locations of incoming hostile aircraft; pilots who were airborne had to seek their own targets for success against the Zeppelins. In one instance, ground personnel placed white arrows pointing along the ground in the general direction of the sighted threat. When the enemy began to fly faster and more elusive zeppelins and bombers, more accurate and timely information was necessary, because there was no effective way to track incoming aircraft.³⁴

The Zeppelin threat accomplished a significant strategic objective. At the end of the war, almost twenty-five thousand personnel and thousands of artillery pieces and shells in the British Home Guard were embroiled in the air defense mission in England. These units and equipment could have been used on the front lines in France instead of the British Isles. More than a dozen Royal Flying Corps defense squadrons with almost two hundred planes and three thousand personnel were also involved in the home air defense mission.³⁵

The Zeppelins disrupted vital war-plant production during blackouts, disorganized communications, and oftentimes wilted British morale. During World War II, the British civilian population would suffer a much worse fate than from the destructive effects of World War I aerial weapons.³⁶

Despite the restrictions imposed upon Germany by the 1919 Treaty of Versailles, the German military managed to develop a modern, credible air force during the interwar period. The treaty, drafted at a time when the aerial threat consisted of biplanes and dirigibles, forbade Germany to make bombers, but said nothing about ballistic missiles. In 1931, Hermann Göring placed Captain Walter Dornberger in charge of a military rocket development program and Hitler placed Gerhard Fieseler in charge of a pilotless airplane program.

It is interesting to note that the German Army (Wehrmacht) produced wingless aircraft or rockets while the German Air Force (Luftwaffe) conducted parallel development on pilotless missiles. There was no close contact between the two designers and staffs, nor did they exchange results from their experiments. However, they both competed for fiscal resources from the government. Missile flight testing and development continued during the early war years.³⁷

The German military designed the pilotless rocket for the greatest possible ease of production. The missile consisted primarily of four sections; the main fuselage, the propulsion unit, and the two wings, which technicians attached just before firing. The rocket was 3 feet wide, 22 feet long and weighed two tons, nearly one ton of which consisted of Amatol, a powerful mixture of TNT and ammonium nitrate. In front of the warhead was the master compass, which could keep the rocket on course. Traveling at 340 miles per hour, it could range approximately 150 miles to its target.³⁸

During the Battle of Britain, Hitler hoped to persuade the English government to sue for peace or at least cease combat actions against Germany. If Great Britain could be removed from any continental conflict with Germany, Hitler could focus all his political and military attention on Russia. Therefore, he decided not to use any weapons of mass destruction against England so as not to erode the possibility for future peace.

After the Battle of Britain, the Allied Bomber Command forced the Luftwaffe onto the defensive through the destruction of large numbers of offensive aircraft and experienced pilots. The devastation of Lübeck, Germany on March 28, 1942, marked the opening of the air offensive by American and British bombers against German

cities. Angered by these attacks on the German homeland, Hitler's previous restraints on using indiscriminate weapons of mass destruction disappeared and on April 24, 1942, he ordered retaliatory attacks against nonmilitary targets. Both the Wehrmacht and the Luftwaffe accelerated development of Hitler's "Vergeltungswaffe," or vengeance weapons.

Intelligence agents on the European continent, ULTRA³⁹ intercepts, and finally aerial reconnaissance of the testing and launch construction sites confirmed the existence of the weapons. In May 1943, Flight Officer Constance Babington-Smith, a member of the British central photographic interpretation unit in London, studied a series of photographs of a site at Peenemünde, Germany, which was situated on the Baltic Sea, near the tiny island of Usedom. She interpreted a small, curving black shadow as an elevated ramp and a tiny T-shaped blot above the ramp as an airplane without a cockpit. This was the first time the British saw and recognized the pilotless rocket, the Vergeltungswaffe-eins or V-1 (Appendix 1). Throughout the summer, intelligence units identified other such installations.⁴⁰

The British feared these weapons of mass destruction could devastate their homeland. On 17 August 1943, the Royal Air Force (RAF) launched an attack on the missile research and development site at Peenemünde. Of the 597 aircraft deployed, 571 dropped nearly 2,000 tons of high explosives and incendiaries in the general area of the installation. More than 700 persons at the station died, including one of the most important rocket experts. The bombing damaged some experimental buildings, but none critically. There were two important consequences of this attack. First, the Germans realized that the Allies would take the necessary efforts to prevent or disrupt the use of these new secret weapons. Second, the Germans dispersed V-weapon activity from Peenemünde to other sites.

In December 1943 the Allied military command used the codeword CROSSBOW to designate the effort to counter German research, experimentation, manufacture, construction, transportation, and firing of vengeance weapons. Efforts began by sending the heavy bombers of the Eighth Air Force on repeated raids against suspected missile launching sites. The American Air Forces not only launched air attacks on suspected compounds but also took the time to conduct mock bombing

raids on full-scale reproductions of the structures observed at launching sites, and to determine the best methods to destroy them from the air.

In extensive experiments with mock V-weapon launching sites at Eglin Field, Florida, the Army Air Corps, with every available weapon and method of attack, proved that the most accurate and economical aerial assault on the launching sites would be from medium-altitude fighter-bombers, not high-level B-17's. Attacking the launching sites required precision; they were so well camouflaged that B-17 pilots using the Norden bombsight could not pick them up at the bombing altitude of six miles.

The American airmen did not want to divert heavy bombers from their strategic campaign against the industrial heartland of Germany to strike CROSSBOW sites. The use of fighter-bombers seemed much more economical than using B-17s and B-24s, but the British military objected. The British believed the launching sites should be attacked with heavy bombers, the maximum force available to the Allies. The British point of view prevailed due to their impending exposure to the effects from these weapons.

On 13 June 1944, seven days after the Allied invasion of Normandy, the Germans fired the first cruise missile, the V-1, in combat in the history of warfare. It flamed across the sky from the Pas de Calais, in northeastern France, and exploded on a railroad bridge in central London, England. In the first two months of V-1 combat, the weapons killed over 5,000 people, injured another 35,000, and destroyed some 30,000 buildings.

On June 18, 1944, General Eisenhower directed that CROSSBOW targets take first priority for bombing over everything except the urgent air support requirements for the ground battle. The new aerial campaign proved to be a disappointment. The large ski-type ramps on which earlier CROSSBOW efforts had concentrated no longer seemed to be in use and the smaller improvised launching sites now used by the Germans did not make good targets for the heavy bombers. RAF Bomber Command and the United States Eighth Air Force flew numerous sorties against the launch sites. The Ninth Air Force, previously occupied with the land battle, flew antimissile missions for seven days in June using medium bombers and achieved the best results

of all three air forces. Nevertheless, the V-1's continued to soar against England at an average rate of 100 per day.⁴¹

Conversely, the V-1 had several weaknesses, including its flight characteristics and the requirement for large, fixed launching ramps. The cruise missile also flew at a constant speed, a constant altitude, and in a generally straight line. These characteristics made it vulnerable to aerial interception and ground-based antiaircraft batteries. During the war, the British defense against the V-1 shot down or destroyed 3,957 of them in the following proportions: fighters, 1,847; antiaircraft artillery, 1,878; barrage balloons, 232.⁴²

The pilotless aircraft was one of the most cost-effective weapons ever produced. For the price of one British Lancaster bomber, crew training, bombs and fuel, Hitler could fire well over 300 V-1s. The results were greatly in the enemy's favor; the ratio of Allied to German cost was nearly four to one. From the period June through September 1944, V-weapon bombings cost the Allies \$100,000,000 in loss of production, while the total cost of missile expenditures for the Germans, was \$25,000,000. Throughout the bombardment, the Nazi Propaganda Ministry touted the V-1 as a decisive weapon and warned of a new and even more terrible weapon, the V-2.⁴³

Hitler and the hierarchy of the Third Reich had high expectations for the V-2 and promised that it would ultimately win the war for Germany. On 8 September 1944, a V-2 rocket successfully impacted near the Port d'Italie in Paris, 180 miles from the firing point. The rocket carried a one ton warhead that struck its target at over five times the speed of sound (Appendix 2). It could not be seen, heard, or intercepted. Having the advantages of surprise and immunity to all known countermeasures, the V-2 achieved an average 5.3 deaths per round, more than double that of the V-1. World War II antiaircraft gunners could do little against the supersonic V-2, except estimate their time of arrival.⁴⁴

The Germans directed V-2 attacks not only against Great Britain, but also Liège and Antwerp, Belgium. Liège was important to the Allies as a rail and communications center and was located along a major supply route. Antwerp was the main port for the delivery of Allied supplies to continental Europe. Hitler hoped to

neutralize the port's effectiveness and selected the center of the city of Antwerp and its docks as targets for the missiles. In all, the Germans fired over 1,300 missiles against Antwerp and Liège, none of which were interdicted by aerial or ground air defense systems. Because of these attacks, manpower had to be diverted from otherwise necessary military functions to civil defense. The V-2 marginally affected the flow of supplies through Antwerp and Liège, leading one to the conclusion that it failed as a weapon of war.⁴⁵

Airpower alone failed to destroy the unconventional air weapons. Crew proficiency launching the rockets enabled the missile crews to resist attempts at aerial interdiction. The German military could fire the rocket from mobile field vehicles and move before detection by Allied ground or aerial reconnaissance. When the Allies crossed the Seine River in northern France, the enemy abandoned his launching sites south of the Somme River, and the V-weapon assault on England partially eased. This event confirmed that depriving the Germans of launching sites was the only effective remedy to the problem. However, V-weapon attacks continued, although with reduced effectiveness, until the Germans surrendered in May 1945.⁴⁶

The Soviet Scud missile that the Iraqi Army used against coalition forces during the 1991 Persian Gulf War was not much more advanced than Hitler's V-2 rockets. German scientists "repatriated" after World War II by the Soviet Union developed the Scud missile in the early 1950s to deliver nuclear warheads on the central European battlefield. During the 43 day conflict, Iraq fired a total of 86 Scud missiles at Saudi Arabian and Israeli targets. They had little or no military impact on the campaign as land, air, and sea operations continued. Only minor damage and loss of life occurred due to Scud missile launches; the sole exception was the successful attack on an American military barracks near Dhahran.⁴⁷

The military ineffectiveness of the Iraqi Scuds during the war could be attributed to four factors. First, the missiles were quite primitive. The Scud was inaccurate, incapable of maneuvering in flight, and carried a small conventional warhead. Iraqi missile construction was so poor, the different sections tended to disintegrate in flight. Second, the Iraqi forces fired the weapons in small numbers, rather than in a barrage; this simplified the formation of adequate defenses against the

missile. Third, the American Patriot anti-tactical ballistic missile proved capable of diverting or destroying many Scuds. Finally, Saddam did not fire Scud missiles at front line maneuver units, oil fields, or ports of debarkation where he might have achieved limited tactical or operational success. Instead, he continued to target coalition forces and cities (designated critical assets) where Patriot missile units were located.⁴⁸

The primary reason the United States demonstrated such tenacity at reducing the Scud menace was to maintain the political integrity of the Allied Coalition. Scud missiles endangered the cohesion of the Coalition by encouraging possible Israeli intervention in the conflict. By launching Scud missiles against Israel, Saddam Hussein attempted to force the Israeli government to retaliate against Iraq. Any intervention by Israel would have resulted in the reduction or curtailment of Arab support for the United Nations mandated sanctions against Iraq. The CINC's doctrinal response to the Scud missile threat was a joint and combined effort that involved air, ground, and maneuver organizations and systems.

Coalition air forces easily gained and maintained air superiority⁴⁹, and then air supremacy.⁵⁰ However, it quickly became clear that offensive counter air is no substitute for a dynamic missile defense. The Scud threat compelled the diversion of large numbers of Coalition air sorties toward their detection and destruction and away from intended targets in central and southern Iraq. An elaborate command and control system went into place to spot the Scud launches and dispatch F-15E Eagles⁵¹ and other Coalition aircraft to destroy the missiles and their associated launchers before they could be used against United Nations forces.

The Coalition air forces destroyed a large number of the known fixed launchers in the first six weeks of the air operation, but could not eliminate all the mobile launchers. The missiles were very difficult to find; they were carried on small trailer-like launchers that could easily be hidden in a building or in a wadi by day, then moved into firing positions at night. At the start of the war, U. S. intelligence analysts guessed that the Iraqis had no more than two dozen movable Scud launchers. At the end of the war, they would revise their estimate upward to several hundred.⁵²

The military even deployed previously untested combat systems in an attempt to locate the Scuds. The Joint Surveillance Target Attack Radar System (JSTARS), a joint Army-Air Force program, was one experimental system that deployed to Operation Desert Shield/Storm. JSTARS, mounted on a militarized Boeing 707 aircraft, is a battle management system that detects, locates, tracks, classifies, and assists in attacking targets beyond the forward line of own troops (FLOT). Orbiting safely behind friendly lines, Army and Air Force operators on board the aircraft simultaneously transmit JSTARS information via data link to multiple Army, Air Force, Marine, and allied operations centers. Two JSTARS aircraft deployed to Operation Desert Storm assumed a circular orbit near suspected Scud launch areas. They provided surveillance information to Coalition aircraft flying airborne combat air patrols and to close air support aircraft flying road reconnaissance on suspected Scud avenues of approach.⁵³

Early warning of Scud missile launches greatly assisted ballistic missile interception. The Air Force Space Command Defense Support Program (DSP) satellites, capable of detecting the launch of ICBM and other type rockets, assisted in the detection and early warning of Scud missile launches during the Persian Gulf War. The Tactical Event Reporting System is a small satellite receiver that provides the CINC with tactical missile launch warning data. The geostationary satellite over the Persian Gulf peninsula (which was not originally programmed to detect Scuds) detected a Scud launch when the missile had reached an altitude of some 15-18 kilometers and it relayed this information to the Air Force's Space Command in Colorado Springs, Colorado. After verification, the information was sent to command posts in the theater of war and to relevant Patriot units. Within two to four minutes of launch, the system provided the theater commander with a warning on the suspected launch location, the time of launch, the type of missile launched, and the course azimuth.⁵⁴

To win the Scud war, the coalition had to hit the missiles before they could be fired. Ground forces of various compositions attempted to engage Scud missile launch sites. American ground commanders fired multiple launch rocket systems (MLRS) and Army tactical missile systems (ATACMS) at suspected missile launch

sites. The use of special operations ground forces proved to be a good offensive method to destroy the Scud missile menace.⁵⁵

In western Saudi Arabia, Major General Wayne Downing (U. S. Army), the commander of the Pentagon's counterterrorist units, formed a secret fusion cell of A-10⁵⁶ Thunderbolt II aircraft and American and British commandos to seek and destroy Scud missiles. Some commandos were delivered by Air Force Pave Low⁵⁷ helicopter into western Iraq; others roamed around the countryside in desert-mobility vehicles. The commandos targeted Iraqi command and control centers that were suspected of providing guidance and information to the Scud launchers. In two weeks, the commandos reportedly destroyed more than a dozen of these facilities during night raids. On February 27, 1991, the final day of the war, allied reconnaissance spotted 26 Scud missile sites near the western border of Iraq preparing for a barrage attack on Israel; the general consensus is the commandos destroyed all 26 missiles.⁵⁸

The U. S. Army's Patriot missile system was the ground air defense system that defeated the Scud missile during the Persian Gulf War. The missile, with its deadly accuracy, quickly emerged as one of the glamour systems of the war. The Patriot battery, or fire unit, provided very low to very high-altitude air defense for ground combat forces and high-value assets as determined by the force commander.

There are three major items of equipment in a Patriot fire unit, an engagement control station (ECS), a radar set, and up to eight launch control stations. The ECS provides the human interface for control of operations and is the only component of the fire unit manned during operations. The ECS controls up to eight launching stations through a radio data link. The two system operators can select either automatic or semiautomatic engagement modes. In the automatic mode, operators monitor the computer which conducts the entire target engagement sequence, although operators can manually override the system if necessary to engage targets. In the semiautomatic mode, operators manually select and engage targets the system has detected.

The centerpiece of the Patriot is the phased-array radar set. Unlike a traditional radar, which uses a spinning dish to scan 360 degrees in azimuth, a

phased-array radar has few moving parts. Its beams are shifted electronically by changing the alignment of the phase. Once a Patriot battery, and its associated radar, is placed into operation, the system is assigned a 120 degree sector in azimuth to search for targets. The ECS may reposition the radar in a matter of minutes to cover a different 120 degree scanning sector. The system has four separate radar arrays in one mobile unit, the first of which detects and tracks targets. The second guides the missile on its final approach before intercept, and the third sends the identification, friend-or-foe, (IFF) signal to possible targets. The IFF function is generally used only against aircraft; if a target has the radar profile of a missile, it is assumed to be hostile. A final radar array provides the electronic countermeasures that send phony radar signals to confuse enemy aircraft.⁵⁹

The launch control station is a remotely operated, self-contained unit, mounted on a sixteen-ton truck with its own power plant. The station carries four missiles mounted within canisters that also serve as a shipping and storage containers. The supersonic missile uses a conventional warhead to destroy the target.

A *materiel change* (MC) is an equipment or software modification made on fielded military systems that provide an enhanced capability to perform the originally intended function. The Patriot anti-tactical missile capabilities (PAC) improved the existing systems ability to provide self-defense for Patriot fire units and collocated critical assets. Deployed to Patriot units in 1988, PAC-1 consists of system radar software modifications that enable the detection, tracking and interception of high-angle approach short-range ballistic missiles.

PAC-2 modifications include software changes that permit the radar to cover an arc from 45 degrees to 90 degrees in elevation, which is the typical approach angle for ballistic missiles in the terminal phase. The PAC-2 missile warhead and its fuse were modified to destroy targets with a ballistic missile's velocity. The Army completed development of PAC-2 missiles in the fall of 1990 and deployed them to Saudi Arabia for Operation Desert Storm. The Patriot batteries, soon to deploy to the desert conflict, had not yet seen the PAC-2 missile.⁶⁰

When President Bush decided to deploy forces to Saudi Arabia, Army planners at Central Command (CENTCOM) quickly recognized that Iraq had a significant

tactical ballistic missile (TBM) capability and that air and sea ports of debarkation could become lucrative targets for Saddam Hussein. After deploying the 82nd Airborne Division's ready brigade, CENTCOM requested that the 11th ADA Brigade, stationed at Fort Bliss, Texas, deploy Patriot fire units to the airbase and port facilities at Dhahran and Ad Damman.⁶¹

During the initial lodgment phase of Operation Desert Shield, the 11th ADA Brigade deployed six Patriot batteries. One battery defended the air base at Dhahran, two others defended ports at Ad Damman and Al Jubayl, and three batteries defended the capital city Riyadh. The 11th ADA Brigade established its headquarters and main command post at Riyadh and its forward command post at Dhahran. In September 1990, the brigade formed Task Force Scorpion, the Army's first Hawk/Patriot task force. The unit's mission was to protect the XVIII Airborne Corps against TBMs and conventional air attack.

In early November, when President Bush decided to give CENTCOM an offensive capability, VII Corps was alerted to deploy from Germany. U. S. Army Europe formed a Patriot/Hawk task force with four Patriot batteries and two Hawk batteries from 32nd Army Air Defense Command units to protect VII Corps. A Hawk battalion with three batteries from Fort Bragg, North Carolina and a Patriot battalion from Germany deployed to guarantee survival of the logistics base at King Khalid Military City (KKMC). One Patriot battalion deployed from Germany to defend the coalition staging area at Bahrain and an additional battery deployed to defend the fighter base at Tabuk.⁶²

Fearing that once the war began Iraq might retaliate against Turkey, from where U. S. and coalition forces launched strikes into Iraq, four American and two Dutch Patriot batteries from Germany deployed to Eastern Turkey. During the war, Iraq never attacked Turkey with Scud missiles, but the deployment of Patriot missiles demonstrated NATO's resolve to reinforce Turkey and notified Saddam Hussein that an attack on Turkey would be considered an attack on NATO.⁶³

On the night of January 17, 1991, Scud missiles landed on Tel Aviv and Haifa, Israel, injuring 12 Israelis. Israeli jets scrambled for what the Bush administration feared would be a quick reprisal. Such a response against Iraq would have

reawakened Arab-Israeli antagonism and unraveled the allied coalition. Within an hour after the first Scud fell, the Bush cabinet assembled and offered U. S. Patriot batteries to defend Israel. Four U. S. fire units and one Dutch battery deployed to Israel to provide point and area air defense coverage against Scud missiles.

The joint force air component commander (JFACC) was a new concept implemented during the Persian Gulf War. CENTCOM designated the commander of Central Command's air forces as the JFACC. He was responsible to coordinate, plan, and deconflict the execution of the overall theater air interdiction campaign, the offensive air campaign, and air defense over all Coalition forces. The JFACC had the responsibility to consult the other component commanders, but he did not have the authority to compel agreement. The CINC would resolve essential disagreements.

The Navy and the Marine Corps resisted the execution of this concept. The Air Force concept of centralized control and decentralized execution conflicted with the Navy's concept of smaller, more autonomous operations. They perceived the JFACC as a threat to their established method of conducting air combat operations and rather than looking for ways to enhance the concept and help refine it to incorporate carrier-based air, they searched for ways to resist the system.

The Marine Corps perceived the JFACC as a threat to their Marine Air Ground Task Force (MAGTF) procedures in which MAGTF aviation is a supporting arm to the Marine ground battle. The JFACC idea of centralized control over all theater air and air defense assets extending horizontally across the entire theater threatened to split the MAGTF for missions outside their area of operation. The Marines prefer to fight as a complete combat force under one service, while the JFACC is a functional organization that has an air and air defense perspective. However, the JFACC concept proved successful, in spite of those efforts to undermine it.

Theater missile defense experience in Operation Desert Storm highlighted several problem areas involved in attacking this time sensitive type of target. First, the cumbersome joint-planning process was slow to react to suspected missile locations. The resulting disjointed surveillance tasking, target selection, and planning functions could not direct sensors and/or weapons to probable target appropriate locations in time. Second, the sensitive nature of surveillance data often required sanitizing

before it could be made available to those outside of the collecting agency. Third, it became clear in the Gulf War that offensive counter air is no substitute for effective missile defense. The coalition air forces did not eliminate the Iraqi missile threat—even though they had overwhelming air superiority and conducted a massive bombardment. Finally, sensors and other weapon seekers were restricted either by weather, darkness, or foliage and camouflage penetration deficiencies that delayed post-strike damage assessment. No one ever knew the exact number of missile and launcher systems that the coalition air forces had damaged and destroyed during the war. The prudent student of war would expect the lessons learned from that conflict, as well as the previous two uses of operational air defenses, to be incorporated into future operational doctrine, organizations, and materiel solutions.⁶⁴

Emerging Operation Air Defense Doctrine, Organizations, and Materiel

Before any nation can accurately design its future military force, it must first define the most likely threat it is apt to confront. In his recent report on the roles and missions and functions of the American armed forces, General Colin Powell made the following comments on theater air defense.

In the near term, the primary threat will be from tactical ballistic missiles. In the longer term, cruise missiles will also become a threat. We expect potential adversaries to direct their ballistic and cruise missile attacks primarily against certain critical, high value targets. Armed with chemical or biological warheads, enemy cruise or ballistic missiles can be a significant threat to maneuver forces and operations.⁶⁵

Theater ballistic missiles in existence and in development generally fall into two categories based on their characteristics—tactical aerodynamic missiles (TAM) and tactical ballistic missiles (TBMs). TAMs have airplane-like qualities in that they are maneuverable, remain within the atmosphere, and usually fly at sub-supersonic speeds. Examples of these types of weapons are cruise missiles such as the V-1, remotely piloted vehicles, and unmanned aerial vehicles.

TBMs are launched into the upper regions of the atmosphere; after running out of fuel, they then fall to earth at supersonic speeds towards their target. TBMs are further subdivided into three different range categories of 300, 600 and 1,000

kilometers. Examples of TBMs in the 300 kilometer range include the Chinese M11, the Soviet Scud B, and the Brazilian SS-300. Missiles in the 600 kilometer range include the Soviet Scud C, the North Korean Nodong-1, the Israeli Jericho 1, the Chinese M-9, and the Brazilian SS-600. There are five known missiles in either existence or development in the 1,000 kilometer range including the Chinese CSS-1, the Iraqi Al Abbas, the North Korean Nodong 2, the Israeli Jericho 2, and the Chinese M18.⁶⁶

For several reasons, theater ballistic missiles, not high performance fixed wing aircraft, will become the preferred military force of Third World nations that can afford to purchase them. First, ballistic missiles can be used to attack deep into enemy territory promptly and with great surprise. As was demonstrated during the Persian Gulf War, they can be fired effectively at night when aircraft available to Third World countries may be unable to operate effectively. Second, aircraft lacking high-quality and expensive electronic countermeasures cannot expect to remain airborne on the modern battlefield. More sophisticated airframes, as well as complex anti-aircraft artillery weapons, will knock them out of the sky. Third, the cost of the fixed wing infrastructure, pilots, mechanics, air bases, and training facilities may be beyond the financial capability of most developing nation states. Fourth, the acquisition of high-performance aircraft could signal hostile intentions to neighboring nations. Ballistic missiles and the available technology can be imported covertly and assembled at the necessary time. Fifth, the internal development of ballistic missiles will remove unwanted dependence on imported aircraft and the associated technology. Finally, even unsophisticated military forces can effectively employ ballistic missiles in combat; Iraq demonstrated this capability during the Persian Gulf War.⁶⁷

There are five approaches to eliminate a nation's ability to acquire, manufacture, or deploy TBMs to secure the safety and survivability of American forces and her allies. These strategies include reliance on arms control to reduce the proliferation of TBMs, preventive armed response, preemptive strikes against suspected TBM launch sites, deterrence based on the threat of retaliation, and a strong defensive ground or space based anti-TBM system.

There appears to be little hope for arms control solutions to proliferation, since TBMs offer a relatively cheap substitute for manned bomber forces. Fifteen nations of the world already possess or are attempting to acquire TBMs. Given the sophistication of current and projected air defense systems, a higher percentage of TBMs could theoretically reach their target and cause at least minor damage, even if the targets are protected by anti-TBM defense systems.

Except for the Persian Gulf War, the United States has had difficulty conducting preventive armed response against suspected TBM threats. During the war, the United States took advantage of hostilities to attack Iraq's chemical munitions factories, nuclear weapons capability, and TBM production sites, even though none of these targets had any direct bearing on Iraq's ability to defend itself in Kuwait.

An alternative to preventive action is preemptive action. This is defined as waiting for a military confrontation or crisis to occur before attempting military action, yet striking the first blow of the altercation. This is what the United States did by attacking Iraq during Operation Desert Storm on 17 January 1991. America was already involved in the region militarily during Operation Desert Shield, yet we initiated the air war, and consequently Operation Desert Storm, before Iraq engaged American forces. Preemptive strikes also pose the risk of higher levels of collateral damage than do preventive strikes. Precision guided munitions will enable this process to be accomplished more effectively, yet many countries are uneasy about striking target nations, such as Iraq, who shield their defensive systems with their civilian population.

Another solution would be deterrence based on the threat of retaliation. The problem here is choosing the weapon with which to retaliate. The United States has stated publicly it will not be the first nation to use nuclear weapons. The moral and political stigma attached to using either chemical or nuclear weapons, even against the most despicable nation, makes their employment extremely difficult, even in retaliation for a strike in kind against American military forces. In summary, the policies of prevention, preemptive strikes, or deterrence offer only limited concrete protection against the emerging TBM threat; destruction of these missiles is the only realistic alternative.

Mass casualty weapons, because of their potential to sway public support, could prove decisive in post-Cold War scenarios. Future conflicts that involve American forces will certainly involve national interests, but they are unlikely to involve national survival. The American way of war does not allow us to accept high casualties in what are likely to be relatively low stakes affairs. The United States military must therefore prepare to counter the threat from weapons of mass destruction on the future battlefield.⁶⁸

The American military doctrinal response to the TBM threat has four components. The tenets of theater missile defense are counterfires, passive defenses, active defenses, and the command, control, communications and intelligence required by these functions. Counterfires consist of operations to destroy an adversary's TBM launching complex directly and to disrupt TBM logistics support through interdiction strikes. Counteroffensive efforts may include special operations ground action inside enemy territory aimed at detecting and destroying TBM launchers. Ground action was the only effective method of reducing the missile threat in World War II and in the Persian Gulf War.⁶⁹

The Air Force believes American airpower can remain the principal instrument of U. S. counteroffensive capabilities against contingency TBM threats. Air action is usually politically and militarily preferable to ground operations. However, airpower effectiveness when ballistic missiles were used against TBMs has been less than satisfactory during the last two wars. The U. S. Air Force Theater Missile Defense Special Project will attempt to overcome the deficiencies of the past concerning the use of airpower in the counterfire role. This project involves the use of airpower to counteract the effectiveness of TBM. The test will evaluate F-15E employment tactics against mobile surface to surface missiles. The primary emphasis will be the integration of on board and off board sensors for targeting movable missiles. A full range of weapons and delivery options that pertain to F-15E avionics will be tested.⁷⁰

The only American surface-to-surface missile system capable of interdicting TBM launch sites is the ATACMS. But its range, approximately 100 kilometers, is too short to strike most Third World missile launch sites. The Army is currently examining the requirement for an extended-range version which would enable the

corps-level operational commander to attack time-sensitive targets such as ballistic missiles out to approximately 500 kilometers.

The United States has also restricted future development on additional systems that could fill this void. The 1987 Intermediate-range Nuclear Force (INF) Treaty limits the possession of land-based surface-to-surface missiles with ranges between 500 and 5,500 kilometers. The Bush administration stopped further development on the follow-on to the Lance missile program, leaving the ATACMS as the only surface-to-surface missile in the U. S. arsenal.⁷¹

Passive defense is another important component of a comprehensive defense against TBMs. This defense against the theater ballistic missile threat involves the survivability enhancement of critical U. S. assets. Passive defense measures include hardening command and communications nodes and operating bases, reliance on mobile facilities such as aircraft carriers; dispersion and cover, concealment, and deception of the location of command and control facilities. Against the threat of chemical munitions, measures such as protective masks, individual protective suits, overpressure systems for command bunkers and armored vehicles, and stockpiles of decontamination equipment could serve as effective deterrents.

While passive measures may not produce the required degree of protection desired by military leadership, they could deter the use of ballistic missiles against possible operational and strategic targets. Adequate protective measures could demonstrate national survivability, resiliency and recoverability against a ballistic missile attack thus depriving a hostile nation of any military benefit for using their weapons of mass destruction.

Active defenses involve neutralization or destruction of TBMs already in flight. They are also intended to prevent the enemy from hitting its planned targets. These are the materiel systems involved in TBM/TAM defense. The Patriot PAC-2 surface-to-air missile system is the world's only existing anti-TBM system, but it has limited effectiveness against most types of threat TBMs. The Patriot PAC-3 upgrade will improve the current missile and its antimissile air defense capability. It will enable the launcher control station to be positioned much further away from the radar. This will extend protective coverage by the system and increase the difficulty for an

enemy to find and destroy Patriot missile batteries. Even with PAC-3 improvements Patriot will not be totally reliable against all classes of TBMs; only a new system will provide the full antimissile protection.

The theater high-altitude area defense (THAAD) materiel system, under development by the U. S. Army, is more promising as a TBM defensive system. THAAD will provide large area protection against TBMs in contingency theaters as well as those where American troops are already deployed. Designed exclusively as an anti-TBM interceptor, the system will engage missiles at high altitudes, minimizing debris and chemical and/or nuclear damage. THAAD will be interoperable with Army air defense systems, Air Force space-based sensors, and NATO air defense systems. Combining the Patriot and THAAD systems into a single anti-TBM architecture should provide coverage against long and short range TBMs.⁷²

The extended range intercept technology (ERINT) missile is designed as an adjunct to the Patriot missile. It is envisioned to be a hit-to-kill missile, in that it destroys the target missile with a kinetic energy rather than a large conventional warhead. The ERINT missile canister will be compatible with the Patriot launcher but will hold four missiles instead of one Patriot missile. The Patriot, ERINT, and THAAD systems should perform effectively against TBMs. The problem is these are all large, heavy systems that cannot easily keep up with ground forces.

Another system, the corps surface to air missile system (Corps SAM) is expected to be available for air defense missions in the twenty-first century. Relying on its superior mobility and high technology, the Corps SAM system is designed to protect key military assets in the corps area and to provide continuous air defense for the supported force as they maneuver. The system is designed to be as mobile as the force it supports. Its high mobility will allow for rapid deployment of its elements in response to evolving battlefield requirements.

Operating in both mature and contingency theaters, the system should defeat TBMs, air to surface missiles, anti-radiation missiles, and TAMs. Corps SAM's expected ability to fire large numbers of missiles and its flexible design will sustain operations in high and medium intensity conflicts. The system will consist of a weapons element, a sensor element and a tactical operations element. Using modular

components, the tactical commander will be able to tailor his Corps SAM air defense force based on mission, enemy, troops available, terrain, and time. ⁷³

A major intent of the Corps SAM system, when used in conjunction with other high altitude systems, is to deny preferred attack options to the enemy. During the Persian Gulf War, the Patriot system demonstrated its ability to counter certain types of ballistic missiles. Potential enemies of the United States have probably studied the results of Operation Desert Storm, particularly the capabilities of the Patriot missile system. It is, therefore, a wise assumption that a prudent enemy will not attack American forces using the same ballistic weapons and procedures as the Iraqi armed forces. Future operational aerial threats to our military forces will be focused against known or perceived weaknesses of American weapon systems like the Patriot. It is for this reason that the Army continues to develop weapon systems like the Corps SAM to preclude giving potential enemies a preferred attack option against our forces.

The U. S. Navy is also involved in theater air defense. There may be circumstances in which contingency forces could rely on sea-based ballistic missile defenses. The technological transfer of anti-TBM developments to maritime vessels could fill the void experienced during this type of warfare. Improvements to the Navy's Standard missile, which is carried by cruisers, destroyers, and frigates, will retain its antiaircraft role as well as acting as an anti-TBM interceptor. Besides protecting the fleet itself, the anti-TBM weapons could defend shore based expeditionary forces following an amphibious assault. The Navy and Army are currently developing a cooperative engagement capability between the Patriot, the proposed Corps SAM system, and the U. S. Navy AEGIS⁷⁴ air defense system. This will enable one system to communicate and coordinate its response with the other systems to any threatening aircraft or missile. ⁷⁵

Battle management/command, control, communications, and intelligence (BMCCCI) is the link between the operational elements of theater missile defense. Developments in this area will provide timely, effective support to meet the warning needs of passive defense, the cueing needs of active defense, and the targeting needs of counterfires. These systems will be the glue that holds the entire missile defense

package together, fostering instant communications between the different antimissile systems.

Joint Precision Strike is an idea that could fulfill some of the functions of the BMCCCI arena. Joint Precision Strike is a set of integrated, multi-service capabilities for locating, identifying, and killing high-value, time-sensitive military ground targets. Success in Precision Strike depends on meshing the global surveillance potential of the United States with a robust communications system. Precision Strike integrates surveillance, target acquisition, strike/mission planning, weapons delivery, and battle damage assessment. This detection-engagement cycle must be executable in all weather, day or night, with precision and accuracy, and in timely response to the commander's operational needs. Additional refinements in organization and procedures for Joint Precision Strike will be defined as the idea matures.

Air defense against strategic and operational aerial weapons of mass destruction will not be a new phenomenon in twenty-first century warfare. There is a wealth of antimissile combat experience available to serve as a basis for the development, construction, and the doctrinal use of emerging operational air defense organizations and systems. A comparison and analysis of the emerging organizations, systems, and doctrinal approaches with the historical use of operational air defenses will determine if future approaches to the potential theater ballistic missile threat reflect the lessons learned during actual antimissile combat.

Comparison and Analysis

The final draft of Field Manual 100-5, Operations states that the object of U. S. Army operations is to impose our will upon the enemy to achieve our national purposes. Success on the battlefield depends upon our ability to conduct operations according to the five tenets of Army operations: initiative, agility, depth, synchronization, and versatility. ⁷⁶

Initiative sets or changes the terms of the battle by action and implies an offensive spirit in the conduct of all operations. Applied to the force as a whole, initiative requires a constant effort to force the enemy to conform to our operational tempo while retaining our own freedom of action. It means running the enemy out of

options, while still having options of our own. In the attack, initiative implies never allowing the enemy to recover from the initial shock of the attack. In the defense, the defender acts rapidly to negate the attacker's initial advantage of choice of time and place of attack.⁷⁷

The air defense mission area supports the seizure and maintenance of the initiative by protecting critical assets designated by the CINC. Examples include command and control centers, maneuver units, and controlling the air environment at the critical time and place. The air defense plan must focus on the destruction of enemy aircraft and should be based upon the intelligence preparation of the battlefield (IPB) formulated with the operational operating systems. During defensive operations, air defenders must anticipate enemy courses of action and be prepared to defeat the enemy before their arrival within engagement range to negate any possible advantages of the attacker.

The second tenet of Army operations is agility. Agility is the ability of friendly forces to act faster than the enemy. The implication is that agility is a prerequisite to seizing and holding the initiative. Agility enables friendly forces to concentrate sufficient forces at the decisive place and time against enemy vulnerabilities by being flexible to the tactical situation. This concentration of strength must be exerted repeatedly so that by the time the enemy reacts to one action, another action has taken its place and disrupted the enemy's plans leading to late, uncoordinated, and piecemeal responses. Air defenders must not be restricted to a single course of action and should possess the capability to adjust missions and priorities when required.⁷⁸

The third tenet of Army operations is depth. Depth is the extension of operations in time, space, and resources. In pursuit of operational objectives, the commander employs joint assets with Army forces to extend his ability to attack the enemy to fight on his terms. To think in depth is to forecast and to anticipate attacking an enemy throughout the depth of the battlefield.⁷⁹

Theater air defense forces must protect friendly maneuver units in the close, deep, and rear areas of the battlefield. They must also be prepared to extend coverage to allied nations that do not have systems for total air defense coverage. Given the

CINC's priorities, operational air defenders must provide counterair protection against the enemy's ability to attack all the battlefield operating systems. The theater air defense structure must deny enemy aerial reconnaissance of unit equipment, locations, deny sanctuary to weapons systems such as attack helicopters, and integrate the counterair operations of other organizations involved in the fight.

Synchronization is the use of time, space and resources to produce maximum relative combat power at the decisive time and place. Synchronization does not mean all activities must occur at the same time; it means the desired effect is achieved by arranging activities in time and space to gain that effect. Synchronization is both a process and a result that requires explicit coordination among the various units and activities participating in any event. Key systems in the operational synchronization effort that should have priority for air defense protection are the fire support, maneuver (ground and air), command and control elements, and all sustainment facilities. Coordination with adjacent and higher units is an important consideration to ensure all elements of power are synchronized in the fight.⁸⁰

The final tenet of Army operations is versatility. Versatility is the ability of units to meet diverse mission requirements and the ability to shift focus, to tailor forces, and to move from one mission to another rapidly and efficiently. Versatility implies a capacity to be multifunctional, to operate across regions throughout the full range of military operations, and to perform at the tactical, operational, and strategic levels of war. The suite of weapons for operational air defense should enable the CINC to tailor forces to protect priority elements in theater. There is a mental state of preparedness required to ensure the air defense force is well trained, well led and properly equipped to perform the necessary tasks when called upon to do so.⁸¹

TRADOC Pamphlet 11-9, Blueprint of the Battlefield provides the criteria for the evaluation of organizations and materiel systems. Operational air defense involves the protection of operational forces from air attack (including attack through or from space) using both defensive and offensive measures to reduce the enemy's air attack capacity.

The two step procedure includes locating, identifying, and classifying enemy aerial platforms, and then matching the appropriate response against them for mission

accomplishment. After targets have been processed for engagement, the air defense commander must allocate targets for attack by different air defense systems. At the theater or operational level, the integration of joint and combined operational air defense force (land, air, sea, and space) is key throughout the process. This integration is conducted to achieve a balanced mix of all available joint and allied operational air defense forces of land, air, and naval components.⁸²

To control the allocation of the various operational air defense forces and weapon systems, the commander must establish airspace control. This will provide safe, efficient, and flexible use of the air (including space). There are two components to airspace control, positive and procedural.

Positive control measures are taken to establish direct controls that minimize mutual interference between operational air defense and other operations. Procedural control measures establish readily identifiable electronic, visual, or other means of identification criteria vital to the survival of friendly aircraft in the event positive control measures fail. Applicable to this function are the identification of friend or foe aircraft and the establishment of hostile criteria to permit the maximum beyond visual range engagement, both of which seek to avoid fratricide.⁸³

Initially, during World War I, the airpower initiative belonged to the attacker. The Germans chose the time and place of the air attack and the defender was powerless to stop it. The British did not view the Zeppelin as a threat to their survival because previous attempts to invade the continent had always come from the sea and not from the air. After the airship arrived over British territory, the military reacted, but they could not defend themselves from the Zeppelin menace. Over time, the air corps developed materiel systems and the necessary doctrine to defeat the German aerial weapons. The cost to the British public for this time was paid for in the loss of industrial capacity, military equipment, and lives. The luxury of time is something tomorrow's air defenders may not have for dealing with future aerial threats.

In the World War I air war the British applied the offensive use of the defense, called forward defense, to attack Zeppelins at the strategic, operational and tactical depths. Strategic bombers bombed Zeppelin factories and assembly areas in Germany, while operational strike bombers attacked dirigible launch sites in Belgium and

France. Tactical air defense consisting of pursuit aircraft, antiaircraft artillery weapons, barrage balloons, and a comprehensive warning system served as the final link in the British air defense hierarchy.

At the start of the Second World War, the initiative belonged to the Nazis. German development of V-weapons went undiscovered by the Allies until the war was almost over. German aerial forces chose the times and places of attack and the Allies did not counter the effect from these aerial platforms until the Germans surrendered. The Allies were unable to regain the operational initiative until they overran the V-weapon launching sites. The British eventually seized the strategic initiative from the Germans. V-weapons became militarily insignificant once the British demonstrated a willingness to accept civilian casualties.

During World War II, the Allies used the methods learned during the previous conflict to attack operational weapons of mass destruction in depth. Strategic bombers attacked V-weapon factories and assembly areas deep in the heartland of Germany. Operational fighter-bombers attacked suspected missile launch platforms off the northern coast of France and the Benelux region. After the D-Day invasion, maneuver forces pressed the attack to overrun or capture suspected V-weapon launch sites. Tactical air defenses consisted of updated versions of the LADA: antiaircraft artillery weapons, identification-friend or foe systems, pursuit aircraft (for defense against the V-1), radar, and a comprehensive early warning system.

Due to the awkward staff relationship between the Luftwaffe and the Wehrmacht, the Germans were unable to synchronize the use of their V-weapons until threatened with destruction from the Allies. Using the missile as a weapon of terror, the V-1 had initial success against British morale, but Hitler did not employ it against the Normandy invasion force. The majority of V-2s fired during the war did not strike military and industrial complexes; they landed near civilian population centers. Had the Germans been able to synchronize V-weapon destructive power against Allied troop concentrations, the results from World War II could have been different.

The Allied antimissile organization of World War II was an ad hoc coalition of British and American air forces, air defense units, and army maneuver units under the combined command and control of the two respective governments. Coordination and

cooperation between the two governments enabled a concentrated antimissile effort to be directed against the German threat. In London, the LADA controlled tactical level air defense weapon systems, both ground and air. The Allied Bomber Command directed operational and strategic strike aircraft to their prospective targets. The ground campaign was under the command and control of the Supreme Allied Commander, General Eisenhower. Ultimately, political decisions, such as which type of aircraft should attack which target and air force versus army effectiveness, did not detract from the ultimate destruction of the V-weapon menace.

During Operation Desert Storm, the aerial initiative started with the Iraqi military; they dictated the time and place of Scud missile engagements. Because of its inability to neutralize the threat, the United Nations coalition was fortunate that Saddam Hussein did not equip Scud missiles with chemical or nuclear weapons. The Coalition possessed overwhelming technological superiority, achieved air supremacy, conducted a massive bombing campaign, and gathered intelligence on the Scud missiles, yet Saddam Hussein still managed to fire almost one hundred Scud missiles during the war. The Saudi and the Israeli governments seized the strategic initiative by demonstrating a willingness to accept limited numbers of civilian casualties without fracturing the political alliance.

Antiair operations in the Persian Gulf War demonstrated the requirement to attack theater ballistic missiles at the full depth of the battlefield. Operational and strategic bombing attacked suspected enemy missile launch sites. Special operations forces operated with Coalition air forces to destroy numerous missiles and their launchers. The Patriot missile system provided point and area defense for designated tactical, operational and strategic assets as determined by the CINC.

Synchronization in the Gulf War enabled the joint and combined forces to provide early warning of Scud missile launches to three different theaters of operation--Turkey, Israel, and Saudi Arabia. The CINC appointed a joint force air component commander (JFACC) to exercise overall synchronization of the air and air defense elements in the command. The JFACC concept worked well and has utility for future conflicts.

Theater missile defense in the twenty-first century will be a critical warfighting skill that the American military should master. In many respects, we have learned from previous attempts to neutralize the ballistic missile threats. Evidence of this is reflected in the four components of theater missile defense doctrine: counterfires, passive defense, active defense, and command, control, communications, and intelligence.

Current theater missile defense doctrine should be sufficient to counter the emerging threat. The necessity to attack the threat at the strategic, operational, and tactical depths of the battlefield is reflected in the counterfires and active defense components. Should the success of our active components be neutralized, passive defensive measures should reduce friendly vulnerability to the effectiveness of enemy aerial weapons. Command, control, communications, and intelligence systems are required if the other components of theater missile defense doctrine are to operate effectively on the battlefields of the future.

Procurement of the emerging air defense systems, (Patriot PAC-3, either THAAD or ERINT, Corps SAM, Aegis improvements, and BMCCCI), is required to mount a credible defense against all the anticipated aerial threats of mass destruction. If a credible theater missile defense system is fielded, a potential enemy will not have any preferred attack options against our maneuver forces. Fielding one or two individual systems in isolation would provide an opportunity for potential enemies to concentrate their efforts on the destruction of that system.

The perfect doctrine used in conjunction with the most technologically advanced material systems will not guarantee victory on the battlefield without a solid organizational structure to provide the necessary leadership and guidance. The only way to maintain an agile air defense network is to ensure the systems can interact with each other and that a single organization makes the decisions to employ the defensive systems.

The United States air defense organization is unique among the world's military forces. All the surface-to-air missile systems in the American military belong to the U. S. Army, yet the Air Force has operational command and control over all air defense forces within a theater of operation. This parallel organizational structure

contributes to the lack of total synchronization of the theater air defense mission. The U. S. Navy's contribution to the process only complicates the problem further as each service is concerned with its own interests and not the structure as a whole.

Conclusions and Recommendations

American forces could be threatened on future battlefields from aerial weapons of mass destruction. The threat to deployed forces is real and is manifested in tactical aerodynamic and tactical ballistic missiles. Deployed by nations hostile to the United States, these weapons could be used against our forces in various regional contingency operations. The British failed in World Wars I and II to develop an effective defensive capability against aerial weapons of mass destruction and experienced significant losses accordingly. The United States need not suffer the same consequences.

The lessons learned from actual combat experience against theater ballistic missiles provide the framework for the construction of future operational air defense systems; it is obvious that the American military has indeed learned several of these key lessons. The first such lesson learned was the need for a comprehensive doctrine.

Our current theater ballistic missile defense doctrine is sound. The individual components (counterfires, active defense, passive defense, and command, control, communications, and intelligence) all contribute to the overall defense against and defeat of threat aerial weapons. It is the application of this doctrine that is incomplete. Unless the force is capable of countering the threat in detail, the doctrine is ineffective.

The military is in the process of fielding two major air defense systems, three improvements to antimissile defense systems, and various command, control, and communications enhancements to enable the theater missile defense hierarchy to function at maximum efficiency. All these weapon systems and enhancements are not necessary if the total effort is properly coordinated.

The net effect of materiel system fielding is to provide an architecture that will protect America's military forces and her allies from the aerial missile threat. Patriot PAC-3 improvements will provide the baseline for defense of ground maneuver forces, provided these improvements are fielded to Patriot battalions. The Corps SAM system

should be fielded to Corps Air Defense Artillery Brigades and Marine Corps Air Wings to provide operational ground commanders with a robust system capable of defeating short-range ballistic missiles as well as low-observable unmanned aerial vehicles, fixed-wing and rotary-wing aircraft. The THAAD system should carry the majority of the burden for theater missile defense. Technology transfers from the THAAD to the Navy should provide redundancy for possible contingency operations. The command, control, communications, and intelligence components must be synchronized with the fielded systems to provide the synergistic effects essential for theater missile defense.

The organization for theater ballistic missile defense is also critical for the survival of the operational maneuver force. Future units must not be the clones of archaic organizations from past wars. Technology has afforded the modern air defender the possibility to attain plateaus about which his forefathers only dreamed about. Instant communications and space-based early warning devices provide theater commanders with the ability to see the battlefield at great depths and have the potential to reduce uncertainty in the formulation of battle plans. We must take advantage of expected technological capabilities and design future organizations accordingly.

A joint theater air defense organization should be created from current Army, Air Force, Naval, and Space Command assets to plan, coordinate, and conduct antiair and antimissile operations. This tactical missile defense joint task force (TMDJTF) should be constituted for regional as well as mid-intensity conflicts. The organization should provide area air defense coverage to critical theater assets as designated by the CINC and should be a subordinate unit under the command and control of the JFACC.

The TMDJTF should be composed of an air defense brigade (four battalions: three Patriot and one THAAD), a tactical fighter wing, a joint intelligence collection and dissemination group, a joint communications group to provide the necessary links and relays for systems integration, and a command and control headquarters, with liaison officers from the Navy and Marine Corps for true integration of theater air defense assets. Naval and Marine forces should have the identical interface and communications equipment to facilitate the seamless flow of information and

coordination. The TMDJTF should be capable of deployment to any of the warfighting CINCs as required. The primary benefits of such an organization would be manifested in wartime, yet can be practiced in peacetime.

The TMDJTF should be the combat developer for all antimissile materiel systems and enhancements. As such, this organization would be responsible to identify and prioritize warfighting needs in the theater missile defense arena and submit them to the joint staff for inclusion in the procurement process. These priorities should not remain under the responsibility of the individual services, thus avoiding the parochial service competition that delay the fielding of necessary doctrine and equipment.

In peacetime, the TMDJTF would be responsible for theater missile defense doctrine, training, personnel and equipment. This organization could produce joint doctrinal manuals in half the time currently required. Each of the contributing services would have a representative within the organization who would prevent the usual parochial arguments in favor of one service over another. Each staff section and represented service would have a vested interest to produce the most dynamic and functional method to conduct theater missile defense, since that section would be responsible for its implementation in wartime. This proposal attempts to eliminate the previous mistakes that have plagued air defenders during the previous three conflicts in which theater missiles have been a factor.

The basic air defense employment principles and guidelines have not changed since World War I. The problems of early warning, detection, identification, and coordination still remain as obstacles which must be overcome for the synergistic destruction of the air threat. The incorporation of lessons learned by previous air defenders involved in theater missile defense with the expected improvements in technology should provide the opportunity to construct an ideal shield of blows against the emerging ballistic missile threat. By elevating the shield of blows to counter theater ballistic missiles, the means to counter the threat will evolve with the threat.

¹ Michael W. Ellis and Jeffrey Record, "Theater Ballistic Missile Defense and US Contingency Operations," Parameters, Spring 1992, p. 26.

² Agility describes the ability of friendly forces to act faster than the enemy and a prerequisite for seizing and holding the initiative. Greater quickness permits the rapid concentration of friendly strength against enemy vulnerabilities. This must be done repeatedly so that by the time the enemy reacts to one action, another has already taken its place, disrupting his plans and leading to late, uncoordinated, and piecemeal enemy responses.

³ Initiative implies an offensive spirit in the conduct of all operations. Applied to the force as a whole, initiative requires a constant effort to force the enemy to conform to our operational purpose and tempo while retaining our freedom of action.

⁴ Depth is the extension of operations in time, space, and resources. These factors vary by echelon and by constraints and restraints given to commanders. The commander should use them to give him the greatest freedom of action commensurate with his mission. The commander obtains the necessary space to maneuver through the use of depth. He considers the effects of distance on his operations.

⁵ Synchronization is the use of time, space, and resources to produce maximum relative combat power at the decisive time and place. It is both a process and a result. Synchronization includes, but is not limited to, the actual massed effects of forces and fires at the point of decision.

⁶ Versatility is the ability to shift focus, tailor forces, and move from one mission to another rapidly and efficiently. It implies a capacity to be multifunctional, to operate across regions throughout the full range of military operations, and to perform at the tactical, operational, and strategic levels of war.

⁷ The allocation of operational air defense targets for attack includes the detection, interrogation, identification, and assignment of air defense forces to attack expected enemy concentrations of targets. Prospective targets are not limited to fixed wing and rotary wing aircraft but also include unmanned aerial vehicles, remotely piloted vehicles, and tactical ballistic missiles.

⁸ The integration of Joint/Combined operational air defense forces implies that more than one service and possibly more than one nation will conduct unified operations all directed towards the single purpose of gaining and maintaining air superiority. The desire for air defense forces is to integrate all the unique service and national assets to accomplish the assigned missions in the most effective and efficient manner.

⁹ Final Draft, FM 100-5, Operations, January 1993, p. 1-1.

¹⁰ Carl von Clausewitz, On War, Edited and translated by Michael Howard and Peter Paret. New Jersey: Princeton University Press, 1984, p. 357.

¹¹ Ibid., 358.

¹² Ibid., 357.

¹³ Ibid., 358.

¹⁴ Ibid., 361.

¹⁵ Ibid., 360.

¹⁶ Ibid., 357.

¹⁷ Ibid., 370.

¹⁸ Ibid., 66.

¹⁹ Chaparral air defense weapon system is a short range missile system mounted on a M113 variant chassis. The system carries four ready-to-fire modified USAF Sidewinder missiles. Eight more missiles are carried on board the modified M548 cargo carrier. The system is being phased out of the Active Army inventory and being replaced by the Avenger.

²⁰ Hawk air defense weapon system is a low to medium altitude antiaircraft missile system that has a range in excess of 40 kilometers against all types of aircraft. Each firing unit has 12 ready-to-fire missiles mounted on four launchers. Operations are controlled from a command post that has the capability to integrate information from additional air sources.

²¹ Colonel John A. Warden, The Air Campaign: Planning for Combat, Washington D. C.: National Defense University Press, (1988): p 36.

²² The Avenger is a short range air defense weapon system composed of pod-mounted Stinger missiles on a pedestal in the back of a high mobility multipurpose vehicle (HMMWV).

²³ The Patriot is a high altitude air defense system originally designed as an antiaircraft system. Improvements to the system now offer limited anti-tactical ballistic missile protection.

²⁴ The Corps Surface to Air Weapon System is designed to replace the Hawk antiaircraft missile system in the year 2005. The system is expected to provide antiaircraft and anti-tactical missile protection for maneuver forces.

²⁵ Wilbur Cross, Zeppelins of World War I, New York: Paragon House, (1991): p. 24.

- ²⁶ Kenneth Schaffel, The Emerging Shield: The Air Force and the Evolution of Continental Air Defense 1945-1960. Washington D. C.: Office of Air Force History, (1991): p. 3.
- ²⁷ Kenneth Schaffel, The Emerging Shield: The Air Force and the Evolution of Continental Air Defense 1945-1960. Washington D. C.: Office of Air Force History, (1991): p. 3.
- ²⁸ Ibid.
- ²⁹ Ibid.
- ³⁰ Wilbur Cross, Zeppelins of World War I, New York: Paragon House, (1991): p. ix.
- ³¹ Ibid., 83-93.
- ³² Ibid., 150.
- ³³ Kenneth Schaffel, The Emerging Shield: The Air Force and the Evolution of Continental Air Defense 1945-1960. Washington D. C.: Office of Air Force History, (1991): p. 26.
- ³⁴ Ibid.
- ³⁵ Wilbur Cross, Zeppelins of World War I, New York: Paragon House, (1991): p. 164.
- ³⁶ Ibid., 180.
- ³⁷ Norman Longmate, The Doodlebugs, London: Hutchinson Publishing Group, (1981): p. 24.
- ³⁸ Ibid., 200.
- ³⁹ ULTRA was the Allies most carefully concealed intelligence triumph of World War II. It enabled the Allies to read the Germans' most confidential wireless communications, encrypted by the enemy's Enigma machines.
- ⁴⁰ Wesley Frank Craven and James Lea Cate, editors, Volume Three, Europe: Argument to V-E Day, January 1944 to May 1945. The Army Air Forces in World War II. Washington D. C.: Office of Air Force History, (1983): p. 84.
- ⁴¹ Russell F. Weigley, Eisenhower's Lieutenants: The Campaign of France and Germany 1944-1945. Bloomington: Indiana University Press, (1981): p. 64, 259.

- ⁴² Józef Garlinski, Hitler's Last Weapons: The underground war against the V1 and V2. New York: Times Books, (1978): 231.
- ⁴³ "Explosive Ancestry," Air Defense Artillery, (January-February 1993): p. 37.
- ⁴⁴ Ibid.
- ⁴⁵ George P. Kennedy, Vengeance Weapon 2: The V-2 Guided Missile, Washington, D. C.: Smithsonian Institution Press, (1983),: p. 40.
- ⁴⁶ "Explosive Ancestry," Air Defense Artillery, (January-February 1993): p. xxvi.
- ⁴⁷ Howard Banks, "Lessons from the Gulf War," Forbes, February 18, 1991, p. 40.
- ⁴⁸ Michael W. Ellis and Jeffrey Record, "Theater Ballistic Missile Defense and US Contingency Operations," Parameters, Spring 1992, p. 11-12.
- ⁴⁹ Air superiority is defined as that degree of dominance in the airbattle of one force over another which permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force. Air Force Manual 1-1, Volume II.
- ⁵⁰ Air supremacy is defined as that degree of air superiority wherein the opposing air force is incapable of effective interference. Air Force Manual 1-1, Volume II.
- ⁵¹ The F-15E is the Air Force's two seat, dual role, totally integrated fighter for all-weather air to air and deep interdiction missions. The F-15E is capable of carrying up to 24,500 pounds of ordnance. The aircraft is also capable of low-altitude, high-speed penetration and precision attacks on tactical targets at night and in adverse weather.
- ⁵² Triumph Without Victory, New York: Random House, (1992): p. 261.
- ⁵³ Ibid., 26.
- ⁵⁴ United States Army Space Institute, U. S. Space Systems Reference Guide, Fort Leavenworth, Kansas, 1991.
- ⁵⁵ Douglas Waller, "Secret Warriors," Newsweek, (June 17, 1991): p. 28.
- ⁵⁶ The A-10 Thunderbolt II is a single seat U. S. Air Force close air support aircraft originally designed to defeat formations of Soviet tanks on the central European battlefield. On board weapon systems include one 30mm machine gun, and various types of free-fall or guided munitions.

- ⁵⁷ The MH-53 Pave Low helicopter is a U. S. Air Force night and adverse weather, special operations aircraft. The helicopter is equipped with terrain-following and terrain-avoidance radar, global positioning radar receivers, titanium armor plating, and mounts for .50-caliber and 7.62-caliber machine guns.
- ⁵⁸ Douglas Waller, "Secret Warriors," Newsweek, (June 17, 1991): p. 28.
- ⁵⁹ "Patriot," Air Defense Artillery, Winter 1985, p. 22.
- ⁶⁰ Jörg Bahnemann and Thomas Enders, "Reconsidering Ballistic Missile Defense," Military Technology, April 1991, p. 50.
- ⁶¹ "Thunder and Lightning," 1991 Air Defense Yearbook, 1991, p. 20.
- ⁶² Ibid.
- ⁶³ Ibid.
- ⁶⁴ Jörg Bahnemann and Thomas Enders, "Reconsidering Ballistic Missile Defense," Military Technology, April 1991, p. 46.
- ⁶⁵ General Colin Powell, "1993 Report on the Roles, Missions, and Functions of the Armed Services," February 1993, pp. III-40.
- ⁶⁶ Charles M. Perry, "Theater Missile Threat and Defense Options in the 1990s," The Annals, September 1991, p. 66.
- ⁶⁷ Ibid.
- ⁶⁸ Air Defense Artillery, (January-February 1993): p. 39.
- ⁶⁹ Mr. Michael W. Ellis and Dr. Jeffrey Record, "Theater Ballistic Missile Defense and US Contingency Operations," Parameters, Spring 1992, p. 19.
- ⁷⁰ USAF Weapons Review, (Winter 92): p. 32.
- ⁷¹ Ibid.
- ⁷² Army, (October 1992): p. 300.
- ⁷³ Ms. Beverly A. Popelka, editor, Weapon Systems: United States Army 1992, p. 53.
- ⁷⁴ The AEGIS system is an anti-air warfare command and control system deployed aboard U. S. Navy guided missile cruisers and guided missile destroyers. The AEGIS system includes the search, track and computer controlled command and decision system to evaluate and engage the highest threat with its missiles and guns.

⁷⁵ General Colin Powell, "1993 Report on the Roles, Missions and Functions of the Armed Forces," (10 February 1993): pp. III-41.

⁷⁶ Draft FM 100-5 (21 August 1992), p. 2-7.

⁷⁷ Ibid., 2-11.

⁷⁸ Ibid., 2-12

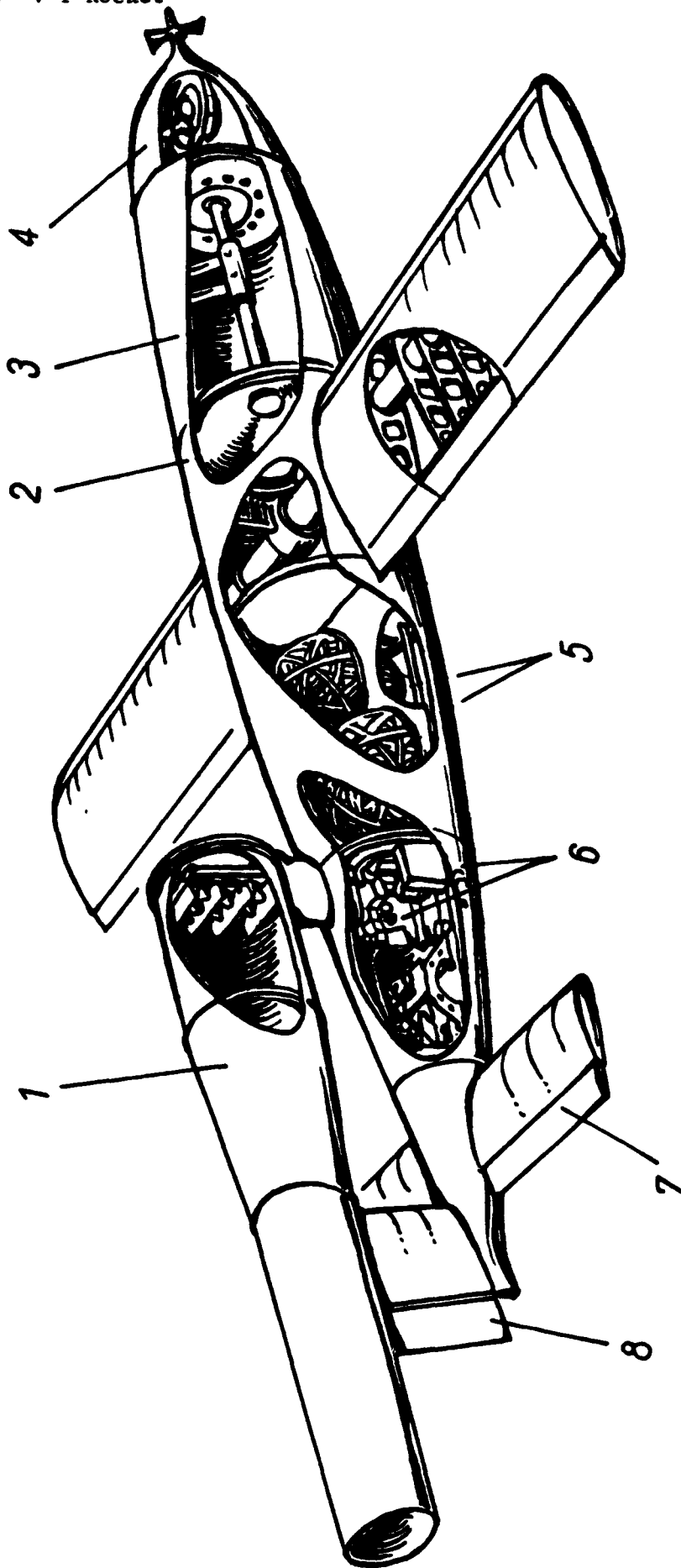
⁷⁹ Ibid., 2-13

⁸⁰ Ibid., 2-14

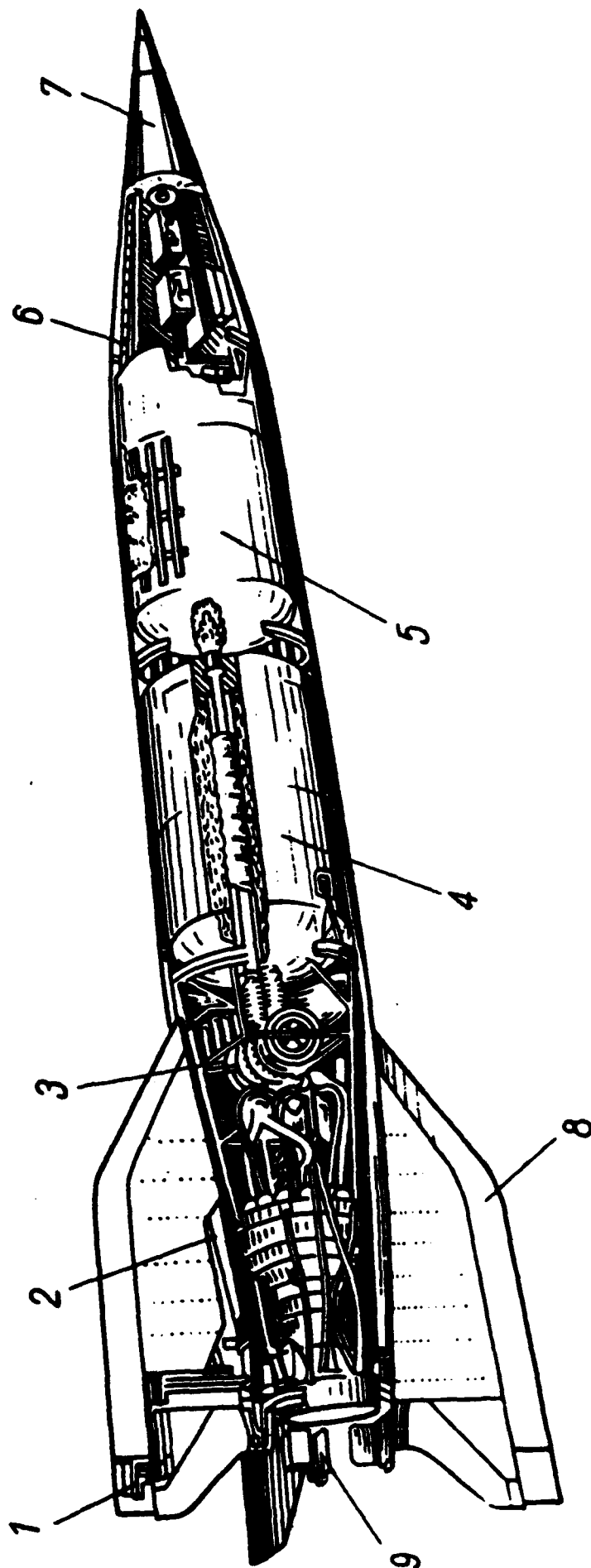
⁸¹ Ibid., 2-16

⁸² TRADOC Pamphlet 11-9, 27 April 1990, p. 44.

⁸³ Ibid.



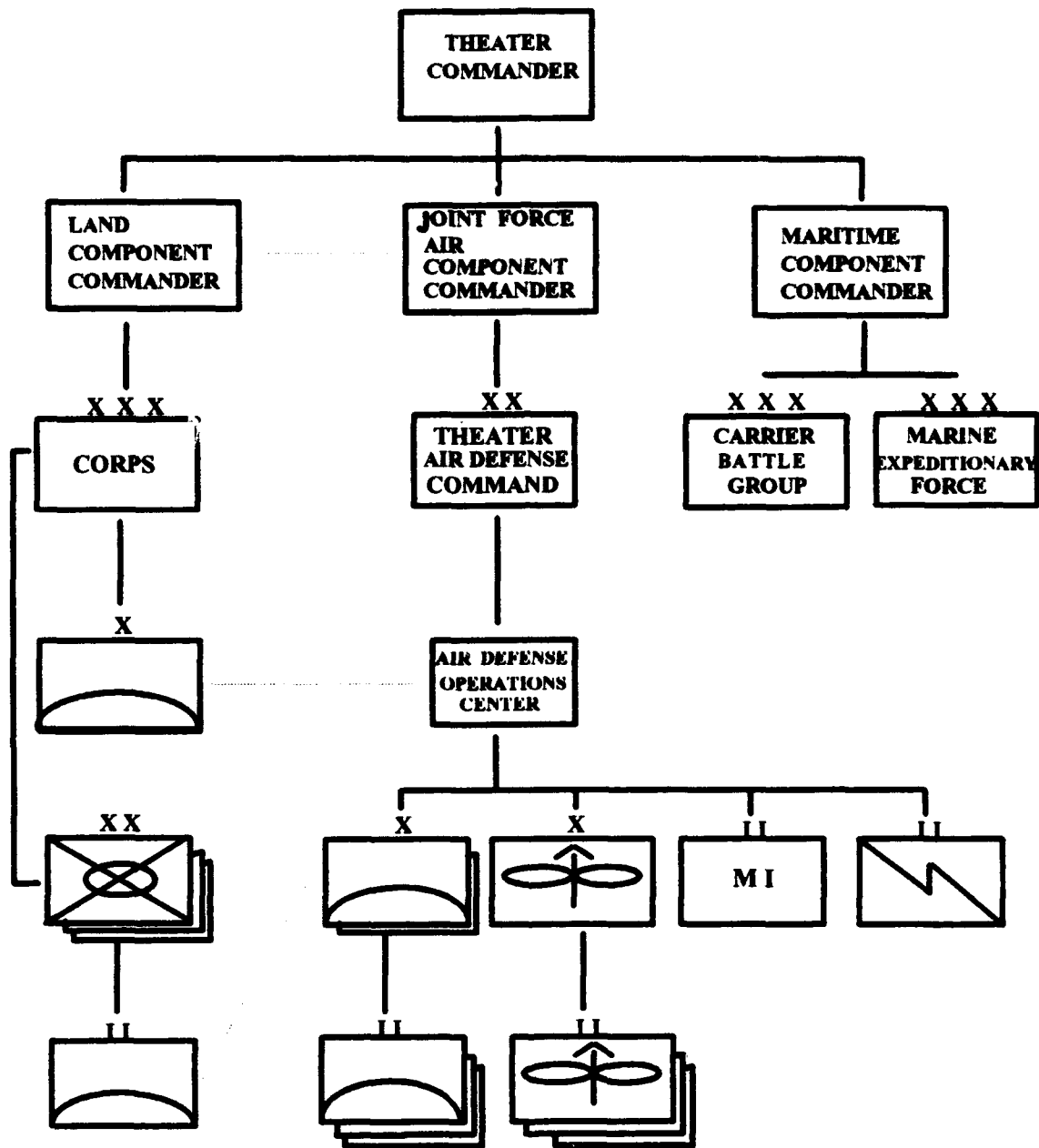
The V-1
1. pulse-jet engine 2. fuel tank 3. warhead 4. magnetic compass 5. compressed air tanks 6. batteries 7. altitude vanes 8. direction vanes



The V-2

1. external vanes 2. rocket motor 3. pumps 4. oxygen tank 5. alcohol tank 6. automatic pilot 7. warhead 8. stabilizers 9. graphite vanes

APPENDIX C: PROPOSED THEATER AIR DEFENSE COMMAND ORGANIZATION



———— OPERATIONAL CONTROL
 COORDINATION

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